CLAIMS

1. Glazing comprising a transparent substrate provided with a stack of thin layers comprising an alternating arrangement of n infrared radiation reflecting functional layers and n+1 dielectric coatings, with $n > 1$, such that each functional layer is surrounded by dielectric coatings, and a barrier layer directly superposed on the last functional layer furthest away from the substrate characterised in that:

(i) the first dielectric coating closest to the substrate comprises a layer made from an oxide, in direct contact with the substrate,

(ii) the internal dielectric coating or coatings surrounded by two functional layers comprise a layer made from a silicon nitride or a silicon oxide with a thickness greater than 5 nm surrounded on both sides by layers made from an oxide other than silicon oxide with thicknesses greater than 5 nm,

(iii) the barrier layer is based on zinc oxide or consists of an indium oxide possibly doped with tin, and

(iv) the last dielectric coating furthest away from the substrate comprises, in order starting from the substrate: a layer made from an oxide other than silicon oxide with a thickness greater than 3 nm and a layer made from a silicon nitride or a silicon oxide with a thickness greater than 10 nm.

2. Glazing according to claim 1, in which the layer made from an oxide in direct contact with the substrate is a layer of zinc-tin mixed oxide.

3. Glazing according to one of claims 1 or 2, in which the layer made from an oxide in direct contact with the substrate has a thickness of at least 20 nm.

4. Glazing according to any one of the preceding claims, in which the layers made from an oxide other than silicon oxide of the internal dielectric coating or coatings are made from zinc-tin mixed oxide.

5. Glazing according to any one of the preceding claims, in which each dielectric coating, with a functional layer superposed on it, comprises a zinc oxide-based layer, directly under and in contact with the functional layer.

6. Glazing according to claim 5, in which each zinc oxide-based layer, directly under and in contact with the functional layer, has a thickness of 15 nm at most, preferably in the range of between 3 and 10 nm.

7. Glazing according to any one of the preceding claims, in which above and in direct contact with each functional layer the stack comprises a barrier layer made from a zinc oxide possibly doped with aluminium or an indium oxide possibly doped with tin.

8. Glazing according to any one of the preceding claims, in which the or each barrier layer has a thickness of 20 nm at most, preferably in the range of between 2 and 18 nm.

9. Glazing according to any one of the preceding claims, in which the last dielectric coating additionally comprises a protective topcoat forming the last layer of the stack and consisting of an oxide, possibly a substoichiometric oxide, of at least one element selected from Ti and Zr.

10. Glazing according to claim 9, in which the protective topcoat has a thickness of 15 nm at most, preferably in the range of between 3 and 10 nm.

11. Glazing according to any one of the preceding claims, in which the stack of thin layers comprises at least or consists of, in order starting from the substrate:

(i) a layer of zinc-tin mixed oxide with a thickness in the range of between 20 and 40 nm,

(ii) a layer of zinc oxide, possibly doped, with a thickness in the range of between 3 and 10 nm,

(iii) a first silver-based functional layer with a thickness in the range of between 9 and 17 nm,

(iv) a barrier layer of zinc oxide, possibly doped with aluminium, with a thickness in the range of between 2 and 16 nm,

(v) optionally, a layer of zinc oxide or a zinc oxide-based layer comprising another metal (e.g. Al) in a Zn/metal weight ratio of at least 80/20, preferably at least 90/10, with a thickness in the range of between 4 and 10 nm,

(vi) a layer of zinc-tin mixed oxide with a thickness in the range of between 10 and 50 nm,

(vii) a layer of silicon nitride with a thickness in the range of between 10 and 50 nm,

(viii) a layer of zinc-tin mixed oxide with a thickness in the range of between 5 and 50 nm,

(ix) a layer of zinc oxide, possibly doped, with a thickness in the range of between 3 and 10 nm,

(x) a second silver-based functional layer with a thickness in the range of between 10 and 20 nm,

(xi) a barrier layer of zinc oxide, possibly doped with aluminium, with a thickness in the range of between 2 and 16 nm,

(xii) optionally, a layer of zinc oxide or a zinc oxide-based layer comprising another metal (e.g. Al) in a Zn/metal weight ratio of at least 80/20, preferably at least 90/10, with a thickness in the range of between 4 and 10 nm,

(xiii) a layer of zinc-tin mixed oxide with a thickness in the range of between 3 and 20 nm,

(xiv) a layer of silicon nitride with a thickness in the range of between 10 and 35 nm, and

(xv) optionally, a layer of titanium-zirconium mixed oxide with a thickness in the range of between 3 and 10 nm.

12. Glazing according to any one of claims 1 to 10, in which the stack of thin layers comprises a layer of a dielectric material with a refractive index higher than 2.2 in at least one of the dielectric coatings.

13. Glazing according to claim 12, in which the dielectric material with a refractive index higher than 2.2 is an oxide of at least one element selected from Ti, Nb and Zr.

14. Glazing according to any one of claims 12 and 13, in which an internal dielectric coating comprises at least or consists of, in order starting from the substrate:

(i) optionally, a layer of zinc oxide or a zinc oxide-based layer comprising another metal (e.g. Al) in a Zn/metal weight ratio of at least 80/20, preferably at least 90/10, with a thickness in the range of between 4 and 10 nm,

(ii) a layer of zinc-tin mixed oxide with a thickness in the range of between 10 and 30 nm,

(iii) a layer of silicon nitride with a thickness in the range of between 10 and 45 nm,

(iv) a layer of zinc-tin mixed oxide with a thickness in the range of between 10 and 30 nm,

(v) a layer of zinc oxide, possibly doped, with a thickness in the range of between 3 and 10 nm,

as well as a layer of titanium-zirconium mixed oxide with a thickness in the range of between 2 and 30 nm between layers (ii) and (iii) or between layers (iii) and (iv) or two layers of titanium-zirconium mixed oxide with a thickness in the range of between 2 and 30 nm, one between layers (ii) and (iii) and the other between layers (iii) and (iv).

15. Glazing according to any one of claims 1 to 10 or 12 to 13, in which the layers made from an oxide other than silicon oxide of the internal dielectric coating or coatings are made from titanium-zirconium mixed oxide.

16. Glazing according to any one of the preceding claims showing a variation in colour in transmission and in reflection between the glazing that has not been heat treated and the heat treated glazing defined by a ΔE^* in single glazing of 8 at most, preferably 5 at most.

17. Glazing according to any one of the preceding claims showing a variation in the light and energy transmission and reflection values between the glazing that has not been heat treated and the heat treated glazing in single glazing of 5 at most, preferably 3 at most.

CLAIMS

1. Glazing comprising a transparent substrate provided with a stack of thin layers comprising an alternating arrangement of n infrared radiation reflecting functional layers and n+1 dielectric coatings, with n > 1, such that each functional layer is surrounded by dielectric coatings, and a barrier layer directly superposed on the last functional layer furthest away from the substrate characterised in that:

(i) the first dielectric coating closest to the substrate comprises a layer made from an oxide, in direct contact with the substrate,

(ii) the internal dielectric coating or coatings surrounded by two functional layers comprise a layer made from a silicon nitride or a silicon oxide with a thickness greater than 5 nm surrounded on both sides by layers made from an oxide other than silicon oxide with thicknesses greater than 5 nm,

(iii) the barrier layer is based on zinc oxide or consists of an indium oxide possibly doped with tin, and

(iv) the last dielectric coating furthest away from the substrate comprises, in order starting from the substrate: a layer made from an oxide other than silicon oxide with a thickness greater than 3 nm and a layer made from a silicon nitride or a silicon oxide with a thickness greater than 10 nm.

2. Glazing according to claim 1, in which the layer made from an oxide in direct contact with the substrate is a layer of zinc-tin mixed oxide.

3. Glazing according to one of claims 1 or 2, in which the layer made from an oxide in direct contact with the substrate has a thickness of at least 20 nm.

4. Glazing according to any one of the preceding claims, in which the layers made from an oxide other than silicon oxide of the internal dielectric coating or coatings are made from zinc-tin mixed oxide.

5. Glazing according to any one of the preceding claims, in which each dielectric coating, with a functional layer superposed on it, comprises a zinc oxide-based layer, directly under and in contact with the functional layer.

6. Glazing according to claim 5, in which each zinc oxide-based layer, directly under and in contact with the functional layer, has a thickness of 15 nm at most, preferably in the range of between 3 and 10 nm.

7. Glazing according to any one of the preceding claims, in which above and in direct contact with each functional layer the stack comprises a barrier layer made from a zinc oxide possibly doped with aluminium or an indium oxide possibly doped with tin.

8. Glazing according to any one of the preceding claims, in which the barrier layer above and in direct contact with the uppermost functional layer has a thickness of 20 nm at most, preferably in the range of between 2 and 18 nm, and/or each barrier layer above and in contact with each functional layer other than the last functional layer has a thickness of 20 nm at most, preferably in the range of between 2 and 18 nm.

9. Glazing according to any one of the preceding claims, in which the last dielectric coating additionally comprises a protective topcoat forming the last layer of the stack and consisting of an oxide, possibly a substoichiometric oxide, of at least one element selected from Ti and Zr.

10. Glazing according to claim 9, in which the protective topcoat has a thickness of 15 nm at most, preferably in the range of between 3 and 10 nm.

11. Glazing according to any one of the preceding claims, in which the stack of thin layers comprises at least or consists of, in order starting from the substrate:

(i) a layer of zinc-tin mixed oxide with a thickness in the range of between 20 and 40 nm,
(ii) a layer of zinc oxide, possibly doped, with a thickness in the range of between 3 and 10 nm,
(iii) a first silver-based functional layer with a thickness in the range of between 9 and 17 nm,
(iv) a barrier layer of zinc oxide, possibly doped with aluminium, with a thickness in the range of between 2 and 16 nm,
(v) optionally, a layer of zinc oxide or a zinc oxide-based layer comprising another metal (e.g. Al) in a Zn/metal weight ratio of at least 80/20, preferably at least 90/10, with a thickness in the range of between 4 and 10 nm,
(vi) a layer of zinc-tin mixed oxide with a thickness in the range of between 10 and 50 nm,
(vii) a layer of silicon nitride with a thickness in the range of between 10 and 50 nm,
(viii) a layer of zinc-tin mixed oxide with a thickness in the range of between 5 and 50 nm,
(ix) a layer of zinc oxide, possibly doped, with a thickness in the range of between 3 and 10 nm,
(x) a second silver-based functional layer with a thickness in the range of between 10 and 20 nm,
(xi) a barrier layer of zinc oxide, possibly doped with aluminium, with a thickness in the range of between 2 and 16 nm,
(xii) optionally, a layer of zinc oxide or a zinc oxide-based layer comprising another metal (e.g. Al) in a Zn/metal weight ratio of at least 80/20, preferably at least 90/10, with a thickness in the range of between 4 and 10 nm,
(xiii) a layer of zinc-tin mixed oxide with a thickness in the range of between 3 and 20 nm,

(xiv) a layer of silicon nitride with a thickness in the range of between 10 and 35 nm, and

(xv) optionally, a layer of titanium-zirconium mixed oxide with a thickness in the range of between 3 and 10 nm.

12. Glazing according to any one of claims 1 to 10, in which the stack of thin layers comprises a layer of a dielectric material with a refractive index higher than 2.2 in at least one of the dielectric coatings.

13. Glazing according to claim 12, in which the dielectric material with a refractive index higher than 2.2 is an oxide of at least one element selected from Ti, Nb and Zr.

14. Glazing according to any one of claims 12 and 13, in which an internal dielectric coating comprises at least or consists of, in order starting from the substrate:

(i) optionally, a layer of zinc oxide or a zinc oxide-based layer comprising another metal (e.g. Al) in a Zn/metal weight ratio of at least 80/20, preferably at least 90/10, with a thickness in the range of between 4 and 10 nm,

(ii) a layer of zinc-tin mixed oxide with a thickness in the range of between 10 and 30 nm,

(iii) a layer of silicon nitride with a thickness in the range of between 10 and 45 nm,

(iv) a layer of zinc-tin mixed oxide with a thickness in the range of between 10 and 30 nm,

(v) a layer of zinc oxide, possibly doped, with a thickness in the range of between 3 and 10 nm,

as well as a layer of titanium-zirconium mixed oxide with a thickness in the range of between 2 and 30 nm between layers (ii) and (iii) or between layers (iii) and (iv) or two layers of titanium-zirconium mixed oxide with a thickness in the range of between 2 and 30 nm, one between layers (ii) and (iii) and the other between layers (iii) and (iv).

15. Glazing according to any one of claims 1 to 10 or 12 to 13, in which the layers made from an oxide other than silicon oxide of the internal dielectric coating or coatings are made from titanium-zirconium mixed oxide.

16. Glazing according to any one of the preceding claims showing a variation in colour in transmission and in reflection between the glazing that has not been heat treated and the heat treated glazing defined by a ΔE^* in single glazing of 8 at most, preferably 5 at most.

17. Glazing according to any one of the preceding claims showing a variation in the light and energy transmission and reflection values between the glazing that has not been heat treated and the heat treated glazing in single glazing of 5 at most, preferably 3 at most.